

National Institute
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National Voluntary
Laboratory Accreditation Program

ISO/IEC 17025:1999
ISO 9002:1994

Scope of Accreditation



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CALIBRATION LABORATORIES

NVLAP LAB CODE 200410-0

ELECTRONIC AUTOMATION INC.

2846 Three Mile Road N.W.
Grand Rapids, MI 49544
Mr. John Rittenhouse
Phone: 616-791-9117 Fax: 616-791-9365
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NVLAP Code: 20/A01

ANSI/NCSL Z540-1-1994; Part 1

Compliant

ELECTROMAGNETICS - DC LOW FREQUENCY

NVLAP Code: 20/E02

AC Current

Best Uncertainty (\pm)^{note 1}

Frequency in Hertz

Range	10 to 20	20 to 45	45 to 1 k	1 k to 5 k	5 k to 10 k
0.029 to 0.32999 mA	0.194% + 0.12 μ A	0.098% + 0.12 μ A	0.098% + 0.2 μ A	0.312% + 0.12 μ A	0.970% + 0.12 μ A
0.33 to 3.2999 mA	0.156% + 0.24 μ A	0.078% + 0.24 μ A	0.078% + 0.24 μ A	0.156% + 0.24 μ A	0.466% + 0.24 μ A
3.33 to 32.999 mA	0.156% + 2.4 μ A	0.078% + 2.4 μ A	0.070% + 2.4 μ A	0.156% + 2.4 μ A	0.466% + 2.4 μ A
33 to 329.99 mA	0.156% + 24 μ A	0.078% + 24 μ A	0.070% + 24 μ A	0.156% + 24 μ A	0.466% + 24 μ A
	10 to 45		45 to 1 k		1 k to 5 k
0.33 to 2.19999 A	0.156% + 234 μ A		0.078% + 234 μ A		0.582% + 234 μ A

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	45 to 65	65 to 500	500 to 1 k
2.5 to 11 A	0.048% + 1552 μ A	0.078% + 1552 μ A	0.256% + 1552 μ A

ELECTROMAGNETICS - DC/LOW FREQUENCY

NVLAP Code: 20/E05

DC Current

Range	Best Uncertainty (\pm) ^{note 1}
0 to 3.29999 mA	0.0102% + 0.04 μ A
0 to 32.9999 mA	0.0078% + 194 μ A
0 to 329.999 mA	0.0078% + 2.6 μ A
0 to 2.19999 A	0.024% + 36 μ A
0 to 11 A	0.048% + 256 μ A

NVLAP Code: 20/E05

DC Resistance

Range in ohms	Best Uncertainty (\pm) ^{note 1}
0 to 10.99	0.0094% + 0.006 ohms
11 to 32.999	0.0094% + 0.008 ohms
33 to 109.999	0.007% + 0.008 ohms

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110 to 329.999	0.007% + 0.008 ohms
0.330 k to 1.09999 k	0.007% + 0.048 ohms
1.1 k to 3.29999 k	0.007% + 0.048 ohms
3.3 k to 10.9999 k	0.007% + 0.48 ohms
11 k to 32.9999 k	0.007% + 0.48 ohms
33 k to 109.999 k	0.0086% + 4.8 ohms
110 k to 329.999 k	0.0094% + 4.8 ohms
0.33 M to 1.09999 M	0.0118% + 44 ohms
1.1 M to 3.29999 M	0.0118% + 44 ohms
3.3 M to 10.9999 M	0.048% + 428 ohms
11 M to 32.9999 M	0.078% + 428 ohms
33 M to 109.999 M	0.388% + 4264 ohms
110 M to 330 M	0.388% + 12792 ohms

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NVLAP Code: 20/E06

DC Voltage

Range

0 to 329.9999 mV

Best Uncertainty (\pm)^{note 1}

0.0048% + 2.4 μ V

0 to 3.299999 V

0.004% + 4 μ V

0 to 32.99999 V

0.004% + 40 μ V

30 to 329.9999 V

0.0044% + 388 μ V

100 to 1000.000 V

0.0044% + 1164 μ V

NVLAP Code: 20/E09

LF AC Voltage

Best Uncertainty (\pm)^{note 1}

Frequency in Hertz

Range

10 to 45

45 to 10 k

10 k to 20 k

20 k to 50 k

50 k to 100 k

100 k to 500 k

1.0 to
32.999 mV

0.274% + 16 μ V

0.118% + 16 μ V

0.156% + 16 μ V

0.194% + 16
 μ V

0.274% + 26
 μ V

0.776% +
48 μ V

33 to
329.999
mV

0.194% + 40 μ V

0.040% + 16 μ V

0.078% + 16 μ V

0.126% + 32
 μ V

0.188% + 132
 μ V

0.544% +
256 μ V

0.33 to
3.29999 V

0.118% + 194 μ V

0.024% + 48 μ V

0.064% + 48 μ V

0.110% + 234
 μ V

0.188% +
1318 μ V

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3.3 to 32.9999 V	0.118% + 1938 μ V	0.032% + 466 μ V	0.064% + 2016 μ V	0.148% + 3876 μ V	0.188% + 13180 μ V
33 to 329.999 V	0.040% to 5.2 mV	0.064% + 12 mV	0.070% + 26 mV		
330 to 1000 V	0.040% to 64 mV	0.156% + 78 mV	0.156% + 388 mV		

NVLAP Code: 20/E10
Capacitance

Range	Best Uncertainty (\pm) ^{note 1}
0.33 nF to 0.4999 nF	0.388% + 0.0078 nF
0.5 nF to 1.0999 nF	0.388% + 0.0078 nF
1.1 nF to 3.2999 nF	0.388% + 0.0078 nF
3.3 nF to 10.9999 nF	0.388% + 0.0078 nF
11 nF to 32.9999 nF	0.194% + 0.078 nF
33 nF to 109.999 nF	0.194% + 0.078 nF
110 nF to 329.999 nF	0.194% + 0.234 nF
0.33 μ F to 1.09999 μ F	0.194% + 0.78 nF
1.1 μ F to 3.29999 μ F	0.268% + 2.34 nF
3.3 μ F to 10.9999 μ F	0.268% + 7.8 nF

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11 μ F to 32.9999 μ F	0.312% + 23.4 nF
33 μ F to 109.999 μ F	0.388% + 78 nF
110 μ F to 329.999 μ F	0.544% + 234 nF
0.33 mF to 1.1 mF	0.776% + 234 nF

NVLAP Code: 20/E12

DC Wattage

Range in W	Best Uncertainty (\pm) ^{note 1}	Remarks
0.000108 to 330	0.03%	33 mV to 1000 V
0.01089 to 1004.5	0.09%	33 mV to 1000 V
0.1485 to 11000	0.07%	33 mV to 1000 V

NVLAP Code: 20/E12

AC Wattage

Range in W	Best Uncertainty (\pm) ^{note 3}	Remarks
0.0001089 to 0.00297	0.312%	33 mV to 329.999 V
0.000297 to 0.01089	0.194%	33 mV to 329.999 V
0.001089 to 0.0297	0.272%	33 mV to 329.999 V
0.00297 to 0.1089	0.194%	33 mV to 329.999 V

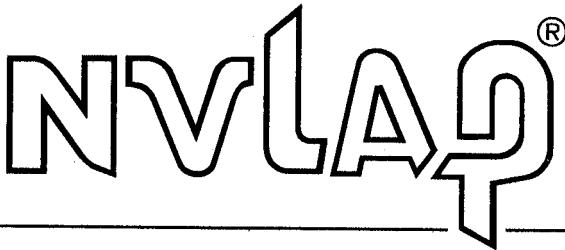
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0.01089 to 0.297	0.272%	33 mV to 329.999 V
0.0297 to 726	0.194%	33 mV to 329.999 V
0.0726 to 1.485	0.272%	33 mV to 329.999 V
0.1485 to 3.63	0.194%	33 mV to 329.999 V
0.001089 to 8.999	0.194%	0.33 to 1000 V
0.00297 to 32.999	0.118%	0.33 to 1000 V
0.01089 to 89.99	0.194%	0.33 to 1000 V
0.0297 to 329.99	0.118%	0.33 to 1000 V
0.1089 to 899.99	0.194%	0.33 to 1000 V
0.297 to 2199.9	0.118%	0.33 to 1000 V
0.726 to 4499.9	0.156%	0.33 to 1000 V
1.485 to 11000	0.118%	0.33 to 1000 V

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NVLAP Code: 20/E15

Phase Angle

Frequency Range in Hz

Best Uncertainty (\pm)^{note 1}

10 to 65	0.12°
65 to 500	0.70°
500 to 1 k	1.6°
1 k to 5 k	4.8°
5 k to 10 k	7.8°

TIME AND FREQUENCY

NVLAP Code: 20/F01

Frequency

Range in Hz

Best Uncertainty (\pm)^{notes 1,7}

Remarks

0.01 to 119.99	0.00194% + 0.78 mHz	(1.6 μs) Jitter
120.00 to 1199.9	0.00194% + 0.78 mHz	(1.6 μs) Jitter
1.200 to 10.000 k	0.00194% + 0.78 mHz	(1.6 μs) Jitter
10.001 to 11.999 k	0.00194% + 11.8 mHz	(109 ns) Jitter
12.00 to 119.99 k	0.00194% + 11.8 mHz	(109 ns) Jitter
120.0 to 500.0 k	0.00194% + 11.8 mHz	(109 ns) Jitter

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OPTICAL RADIATION

NVLAP Code: 20/O02

Color Temperature

Range in °Kelvin	Best Uncertainty (\pm) in °Kelvin ^{note 1}	Remarks
2300	20	Light Booths
2856	25	Light Booths
2300	11	Incandescent Lamps
2856	14	Incandescent Lamps

THERMODYNAMIC

NVLAP Code: 20/T07

Temperature RTD, °C

Simulated output in ohms

Range in °C	Best Uncertainty (\pm) in °C ^{note 1,6}	Type
-200 to -80	0.040	Pt385, 100 ohm
-80 to 0	0.040	Pt385, 100 ohm
0 to 100	0.056	Pt385, 100 ohm
100 to 300	0.070	Pt385, 100 ohm
300 to 400	0.078	Pt385, 100 ohm

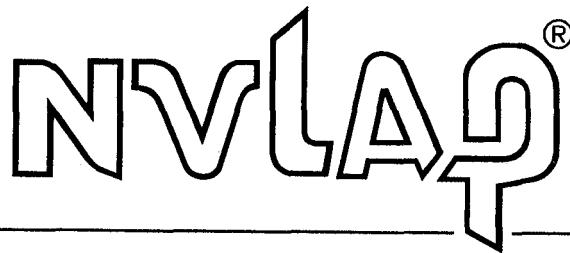
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400 to 630	0.094	Pt385, 100 ohm
630 to 800	0.180	Pt385, 100 ohm
-200 to -80	0.040	Pt392.6, 100 ohm
-80 to 0	0.040	Pt392.6, 100 ohm
0 to 100	0.056	Pt392.6, 100 ohm
100 to 300	0.070	Pt392.6, 100 ohm
300 to 400	0.078	Pt392.6, 100 ohm
400 to 630	0.094	Pt392.6, 100 ohm
-200 to -190	0.194	Pt391.6, 100 ohm
-190 to -80	0.032	Pt391.6, 100 ohm
-80 to 0	0.040	Pt391.6, 100 ohm
0 to 100	0.048	Pt391.6, 100 ohm
100 to 260	0.056	Pt391.6, 100 ohm
260 to 300	0.064	Pt391.6, 100 ohm
300 to 400	0.070	Pt391.6, 100 ohm
400 to 600	0.094	Pt391.6, 100 ohm

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600 to 630	0.180	Pt391.6, 100 ohm
-200 to -80	0.032	Pt385, 200 ohm
-80 to 0	0.032	Pt385, 200 ohm
0 to 100	0.032	Pt385, 200 ohm
100 to 260	0.040	Pt385, 200 ohm
260 to 300	0.094	Pt385, 200 ohm
300 to 400	0.102	Pt385, 200 ohm
400 to 600	0.110	Pt385, 200 ohm
600 to 630	0.126	Pt385, 200 ohm
-200 to -80	0.032	Pt385, 500 ohm
-80 to 0	0.040	Pt385, 500 ohm
0 to 100	0.040	Pt385, 500 ohm
100 to 260	0.048	Pt385, 500 ohm
260 to 300	0.064	Pt385, 500 ohm
300 to 400	0.064	Pt385, 500 ohm
400 to 600	0.070	Pt385, 500 ohm
600 to 630	0.086	Pt385, 500 ohm

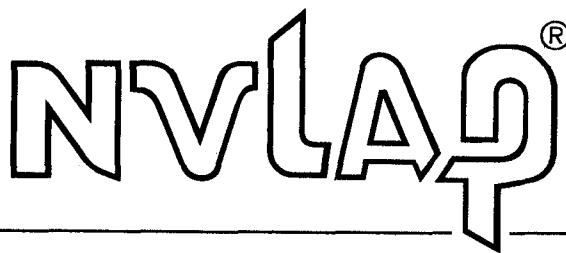
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-200 to -80	0.024	Pt385, 1000 ohm
-80 to 0	0.024	Pt385, 1000 ohm
0 to 100	0.032	Pt385, 1000 ohm
100 to 260	0.040	Pt385, 1000 ohm
260 to 300	0.048	Pt385, 1000 ohm
300 to 400	0.056	Pt385, 1000 ohm
400 to 600	0.056	Pt385, 1000 ohm
600 to 630	0.180	Pt385, 1000 ohm
-80 to 0	0.064	Ni 120 ohm
0 to 100	0.064	Ni 120 ohm
100 to 260	0.110	Ni 120 ohm
-100 to 260	0.234	Cu427, 10 ohm

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Temperature, RTD °F

Range in °F	Best Uncertainty (\pm) in °F ^{notes 1,6}	Type
-328 to -112	0.072	Pt385, 100 ohm
-112 to 32	0.072	Pt385, 100 ohm
32 to 212	0.102	Pt385, 100 ohm
212 to 572	0.126	Pt385, 100 ohm
572 to 752	0.142	Pt385, 100 ohm
752 to 1166	0.170	Pt385, 100 ohm
1166 to 1472	0.324	Pt385, 100 ohm
-328 to -112	0.072	Pt392.6, 100 ohm
-112 to 32	0.072	Pt392.6, 100 ohm
32 to 212	0.102	Pt392.6, 100 ohm
212 to 572	0.126	Pt392.6, 100 ohm
572 to 752	0.142	Pt392.6, 100 ohm
752 to 1166	0.170	Pt392.6, 100 ohm
-328 to -310	0.350	Pt391.6, 100 ohm
-310 to -112	0.058	Pt391.6, 100 ohm

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-112 to 32	0.072	Pt391.6, 100 ohm
32 to 212	0.088	Pt391.6, 100 ohm
212 to 500	0.102	Pt391.6, 100 ohm
500 to 572	0.116	Pt391.6, 100 ohm
572 to 752	0.126	Pt391.6, 100 ohm
752 to 1112	0.142	Pt391.6, 100 ohm
1112 to 1166	0.324	Pt391.6, 100 ohm
-328 to -112	0.058	Pt385, 200 ohm
-112 to 32	0.058	Pt385, 200 ohm
32 to 212	0.058	Pt385, 200 ohm
212 to 500	0.072	Pt385, 200 ohm
500 to 572	0.170	Pt385, 200 ohm
572 to 752	0.184	Pt385, 200 ohm
752 to 1112	0.198	Pt385, 200 ohm
1112 to 1166	0.228	Pt385, 200 ohm
-328 to -112	0.058	Pt385, 500 ohm
-112 to 32	0.072	Pt385, 500 ohm

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32 to 212	0.072	Pt385, 500 ohm
212 to 500	0.088	Pt385, 500 ohm
500 to 572	0.116	Pt385, 500 ohm
572 to 752	0.116	Pt385, 500 ohm
752 to 1112	0.126	Pt385, 500 ohm
1112 to 1166	0.156	Pt385, 500 ohm
-328 to -112	0.044	Pt385, 1000 ohm
-112 to 32	0.044	Pt385, 1000 ohm
32 to 212	0.058	Pt385, 1000 ohm
212 to 500	0.072	Pt385, 1000 ohm
500 to 572	0.088	Pt385, 1000 ohm
572 to 752	0.102	Pt385, 1000 ohm
752 to 1112	0.102	Pt385, 1000 ohm
1112 to 1166	0.324	Pt385, 1000 ohm
-112 to 32	0.116	Ni120, 120 ohm
32 to 212	0.116	Ni120, 120 ohm

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212 to 500	0.198	Ni120, 120 ohm
-148 to 500	0.422	Cu427, 10 ohm

NVLAP Code: 20/T08

Temperature

Thermocouple, °C

Simulated output in V

Range in °C	Best Uncertainty (\pm) in °C ^{notes 1,4,5}	Type
600 to 800	0.342	B
800 to 1000	0.264	B
1000 to 1550	0.234	B
1550 to 1820	0.256	B
0 to 150	0.234	C
150 to 650	0.202	C
650 to 1000	0.242	C
1000 to 1800	0.388	C

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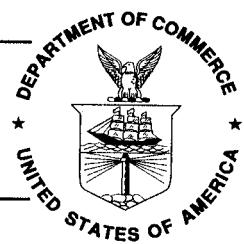
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1800 to 2316	0.652	C
-250 to -100	0.388	E
-100 to -25	0.126	E
-25 to 350	0.110	E
350 to 650	0.126	E
650 to 1000	0.164	E
-210 to -100	0.210	J
-100 to -30	0.126	J
-30 to 150	0.110	J
150 to 760	0.132	J
760 to 1200	0.180	J
-200 to -100	0.256	K
-100 to -25	0.140	K
-25 to 120	0.126	K
120 to 1000	0.202	K

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1000 to 1372	0.312	K
0 to 250	0.442	R
250 to 400	0.272	R
400 to 1000	0.256	R
1000 to 1767	0.312	R
0 to 250	0.366	S
250 to 1000	0.280	S
1000 to 1400	0.288	S
1400 to 1767	0.358	S
-250 to -150	0.490	T
-150 to 0	0.188	T
0 to 120	0.126	T
120 to 400	0.110	T

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ELECTRONIC AUTOMATION INC.

Temperature

Thermocouple, °F

Range in °F	Best Uncertainty (\pm) in °F ^{notes 1,2,4,5}	Type
1112 to 1472	0.616	B
1472 to 1832	0.476	B
1832 to 2822	0.422	B
2822 to 3308	0.462	B
32 to 302	0.422	C
302 to 1202	0.364	C
1202 to 1832	0.436	C
1832 to 3272	0.700	C
3272 to 4201	1.174	C
-418 to -148	0.700	E
-148 to -13	0.228	E
-13 to 622	0.198	E
622 to 1202	0.228	E

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1202 to 1832	0.296	E
-346 to -148	0.378	J
-148 to -22	0.228	J
-22 to 302	0.198	J
302 to 1400	0.238	J
1400 to 2192	0.324	J
-328 to -148	0.462	K
-148 to -13	0.252	K
-13 to 248	0.228	K
248 to 1832	0.364	K
1832 to 2502	0.562	K
32 to 482	0.796	R
482 to 752	0.490	R
752 to 1832	0.462	R
1832 to 3212	0.562	R

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NVLAP LAB CODE 200410-0

ELECTRONIC AUTOMATION INC.

32 to 482	0.660	S
482 to 1832	0.504	S
1832 to 2552	0.520	S
2552 to 3212	0.646	S
-418 to -238	0.882	T
-238 to 32	0.340	T
32 to 248	0.228	T
248 to 752	0.198	T

1. Represents an expanded uncertainty using a coverage factor, k=2.
2. The uncertainties shown are for ratiometric reading only.
3. Uncertainty at 45 to 65 Hz, PF-1, only.
4. Best uncertainty does not include thermocouple error.
5. The uncertainties shown are for both generating and reading.
6. The uncertainty shown is for generating RTD equivalence only.
7. Jitter uncertainty will be treated as random and its influence will vary as to counter design.

December 31, 2003

David T. Alderman

Effective through

For the National Institute of Standards and Technology